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5. *The Auriferous and other Metalliferous Districts of Northern Queensland.* Extracts from a Paper read before the Royal Society of New South Wales, on 3rd September, 1867, by the Rev. W. B. CLARKE, M.A., F.G.S.

(Communicated by Sir GEORGE BOWEN, Governor of Queensland, through the COLONIAL OFFICE.)

A copy of this Paper sent to the Society was accompanied by a Despatch from Sir George Bowen, containing the following observations :—

“Brisbane, Queensland, 16th Sept., 1867.

“In commenting on this Paper, one of the leading journals of New South Wales (the ‘Sydney Morning Herald’) has observed that, as a perfect acquaintance with the scientific principles of geology enabled Sir Roderick Murchison, more than twenty years ago, to predict the future discovery of gold in Australia, so Mr. Clarke and other eminent geological observers have been able to point with similar certainty to various parts of this continent where a search for gold-fields might be prosecuted with success. By a careful study of the physical conformation of the country, combined with the minute observation and patient comparison of collateral facts, Mr. Clarke has, during a series of years, guided the exploring ‘digger,’ not only in New South Wales, but also in Victoria and Queensland, to places where gold exists in large natural deposits. These scientific predictions have been verified by the help of Mr. Daintree, formerly employed on the geological survey of Victoria. The observations of this gentleman are embodied in Mr. Clarke’s Paper now transmitted. The gold-bearing country indicated appears to be not less than 900 miles in length from south-east to north-west. It is stated that many of the auriferous spots are likely to prove very rich. The ‘Cape River Gold Field,’ in about latitude $20^{\circ} 30' S.$, and longitude $145^{\circ} 30' E.$, which has recently been proclaimed by my Government under the existing Gold Fields’ Act, is about 70 miles long by from 10 to 15 broad. The ‘diggings,’ already occupied by a considerable number of miners, are situated about 40 miles from the head of the Cape, and about 100 miles from the junction of that river with the Suttar, and about 200 miles inland from the seaport town of Bowen. It will be seen that Mr. Daintree has entered fully into the geology of this district, and has given some interesting information with respect to the Silurian rocks of Northern Queensland. He further observes that, ‘although the area of the auriferous rocks is considerable both on the Cape and Clarke Rivers (another of Mr. Clarke’s predictions), still it is small when compared with the extent of the old metamorphic gold-bearing slates of the Upper Gilbert,’ a river flowing into the Gulf of Carpentaria.

“It will be seen that Mr. Clarke’s Paper also treats of the discovery in Northern Queensland of iron and of copper in great purity and abundance. These ores are found in proximity with extensive beds of coal. Mr. Clarke remarks, in conclusion, that in bringing forward so extensive a subject, he had been compelled to be as brief as possible, but that ‘enough has been said on this occasion to show that our sister colony of Queensland has every reason to anticipate for her northern districts a future of success in the development of the metalliferous riches with which she has been endowed.’

Such development will, it is hoped, gradually take place through the introduction of English capital as the varied resources of this colony may become better known in the mother country. Meanwhile I venture to suggest that a copy of this despatch and of the enclosed paper should be forwarded to the Royal Geographical Society. The President of that Society, Sir Roderick

Murchison, cannot fail to be gratified by these proofs of the realisation by succeeding geologists of his own scientific predictions of the mineral wealth of Australia.

"I have, &c.,
"G. F. BOWEN."

EXTRACTS from the REV. MR. CLARKE'S PAPER.

In prefacing what I have to say upon one of the more immediate subjects of the present communication, it may be well to call attention to the striking fact that the great western interior of this continent is bounded to the eastward by a series of generally high insulated ranges, which preserve a nearly meridional direction on either side of the 140th degree of longitude.

Such is the great mass of the South Australian Ranges to the westward of that meridian, and such are the less lofty but rocky fastnesses of the Barrier and Grey ranges of Sturt to the eastward of it; and such also are the ranges at and above the head of the Cloncurry River of Burke and Wills, and that great range to the eastward of the latter, which was discovered by M'Kinlay, and which bears his name. This range is, in all probability, connected with the Barrier and Grey ranges of Sturt, as it is in direct prolongation of their strike.

The whole of these mountain masses are made up of ancient rocks of metalliferous character, and are surrounded by tertiary and post-tertiary deposits, which are partially auriferous, the detritus or drift having received its gold from the disintegration of the quartz veins which intersect certain portions of the older formations.

These ancient masses rise like fragmentary relics of islands (which, undoubtedly, they once were, in tertiary times) out of the present levels of the surrounding deserts, through which the drainages of the still more eastern Cordillera of New South Wales and Queensland diverge to south-west and north-west, transverse to each other in direction, but yet rudely parallel with the respective lines of the eastern and north-eastern coasts, which may be said, for convenience, to meet, as the general trends of the Cordillera do, between the 28th and 29th parallels of latitude. As the western coast of York Peninsula, though extremely low, is nevertheless well defined, and does not very considerably deviate from the general boundary of the South Australian masses along Spencer's and St. Vincent's gulfs—we may consider Eastern Australia to be a distinct and well-defined division of the continent; especially as we now know that the most western waters, which reach Spencer's Gulf to the south-west, and those which pass to the south-eastern corner of the Gulf of Carpentaria rise very near to each other,—countenancing an idea, which is not, however, yet established, that there was once a communication between those localities.

A careful inspection of the chart of Australia—now gradually but nevertheless rapidly being filled in—will show that the coast lines also rudely follow the strike of the main Cordillera and that a series of the lines drawn in their direction will divide the country into mathematical figures of a tolerably regular shape; in fact, no country is in this respect better defined than Australia.

Another feature of the physical conformation of Australia is the persistency with which certain of the older formations follow a geological strike along the meridian or within certain angular deviations from it; so that they recur in the same direction, where the denudation of younger overlying deposits exposes them to an outcrop, and this is most distinctly the case along the extension of the Cordillera to the westward nearly throughout Victoria.

It was this and other collateral facts which very much guided me in pointing out many years ago certain auriferous tracts not only in New South Wales proper, but in Victoria and Queensland, which both at that time belonged to this territory.

It is chiefly of the more westerly portion of these tracts that I have now to speak. In reply to inquiries of various correspondents and applicants in person relating to the Peak Downs district, I long ago advised them to carry their investigations towards the north-west, into and beyond the scrubs of the Suttor River, under the conviction that between that river and the bends of the Lynd there would be found an extension of the auriferous region. And this advice has been found to be in accordance with the results.

It may be proper to give a general geological sketch of the structure of that part of the country which is under discussion.

It will then be seen that in about 18° s., and between 144° and 145° e., the Burdekin and Lynd rivers of Leichhardt head in a gigantic range striking about N.N.E., the latter flowing to north-west, and the former south-easterly. This river flows through a tract of country occupied by granite, pegmatite, gneiss, talc-slate, mica-slate, and limestone, with quartz veins, porphyry, and basalt; being overlain by deposits of conglomerate and sandstone, which are intruded into and broken, contorted and altered by igneous rocks. The basalt, which seems to me, so far as I have examined it, to be as recent as that which forms the upper rock of that name in Victoria, occupies a plateau at the head of the rivers, and as far to the south as the Clarke River, in which it assumes in places the lava-like character which distinguishes much of the country near Melbourne.

Leichhardt and Gregory both describe the occurrence of these formations, and both speak of streams of lava. There can be no doubt then that it is a region of disturbance; the older formations being also highly inclined, and the newer horizontally bedded, these being also occasionally hardened and tilted.

From an examination of collections made by Leichhardt, Gregory, M'Kinlay, and other explorers, I could have no hesitation in believing that gold would exist in that region, otherwise so much in accordance with physical facts elsewhere observed.

Since Gregory's journey, the discoveries of Burke and Wills, and (in search of them) Walker's, M'Kinlay's, and Landsborough's, and still more recently the explorations of Jardine and Daintree have added much to our geological, as well as geographical knowledge of the region between the 141st and 145th meridians. The courses of the new rivers Norman and Einnasleigh which flows to the Staaten of the Dutch have been discovered, and adjustments of the Lynd and Gilbert have taken place somewhat in advance of Leichhardt's arrangement of those waters. We know now also that the waters of the Thomson, to which the Barcoo of Mitchell appears to be a tributary, and the Flinders rise in the same range, not more than from 170 to 200 miles from the Burdekin, and about 200 or 240 from the Cape River which was discovered by Leichhardt as a tributary of the Suttor, and which it enters not many miles from the junction of the latter with the Burdekin.

Within the limits of these boundaries, which by the Suttor is connected with Peak Downs, and then on to Broad Sound, Canoona, Rockhampton, Gladstone, the Don, the Mary, and Brisbane, we have various tracts of greater or less auriferous promise, those tracts cropping out amidst surrounding deposits of middle and upper palæozoic and secondary formations, and overlying areas of tertiary and post pliocene age. The range of country here indicated cannot be less than 900 miles in length from south-east to north-west; and although some of the auriferous spots may not be more rich than the immediate vicinity of Brisbane, yet there are others of a more important character, and even more so than any yet fully developed in Queensland. If, again, we take into account the Fanning River, Keelbottom Creek, Star Creek, and others westward and eastward of the Burdekin, there must undoubtedly be a vast amount of gold yet to be discovered, though, probably, at wide intervals. In this brief summary I do not mention with much expectation the abundant occur-

rence of such gold as was discovered by me in the quartz pebbles of the secondary fossiliferous rocks of Fitzroy Downs, because that fact may merely testify to the derivation of the quartz from auriferous reefs in secondary times (a very important deduction on another account), and recently an exploration by prospectors of the country 150 miles north-west of Roma, on the Fitzroy Downs, has not resulted in any discovery of alluvial gold, probably because that whole country is of secondary age.

If, however, we include Talgai and other places near the northern boundary of New South Wales, and some mentioned in my own reports, we shall see that Queensland offers ground for great expectation of auriferous wealth. With her coal-fields on the Isaac, the Mackenzie, the Bowen, and at Hervey's Bay, on the Bremer and the Brisbane, the Dawson and the Condamine, she becomes connected with similar coal deposits on the Clarence River, in New South Wales, and by her abundant wealth in copper and iron, bids fair to balance the present superior advantages of our own territory in coal and gold.

The occurrence of copper with gold in some localities in Queensland is also very remarkable. In other places the copper is so rich as to rival the wonderful masses of Lake Superior, the lodes being made up of little else than native copper, without any trace of gold. Whilst in other localities, again, the copper occurs distinct from, but in close proximity to an auriferous area. Such appears to be the case about Mount Wyatt, near the junction of the Burdekin and Suttor, as gold is scattered in the drift all the way to the Belyando.

This leads me back to the Cape River Gold-field.

The Cape River is merely indicated on the chart as entering the Suttor ; but it has lately been explored, where practicable, to its head, and stations are occupied between its junction and Hughenden, on the head of Jardine Creek, which is the Macadam River of Walker, and forms one chief head of the Flinders.

From the head of the Flinders, as I learn from another friend, gold may be found in small particles for some distance down the river, though Jurassic and Cretaceous rocks cover the older formations over a large area, as proved by the abundance of fossil shells, &c., and by remains of reptiles, as, for instance, at the base of Bramston Range, at Marathon, on Richmond Downs, on O'Connell Creek, and elsewhere. These rest upon the underlying palæozoic or older deposits which extend to the Burdekin and Suttor.

It is remarkable that Sir Thomas Mitchell should have turned back from the Belyando River, which would have led him to the Suttor, Cape, and Flinders rivers, and have given him his long desired approach to Carpentaria. Mr. Gregory did not see the junction ; but he tells us, what is most significant, that he passed over great abundance of drift, and of such a character as seems to be indicative, to a certain degree, of a gold region. Leichhardt also states that the ridges were covered with pebbles. Trap and porphyry occur not far off, and the rocks are often highly inclined.

It has been already stated that gold has been found at the head of the Flinders. Mr. Daintree reports to me that about 40 miles from the head of the Cape, and from 90 to 100 miles (direct, I presume) from the junction with the Suttor, on a tributary called "Betts's Mistake" Creek, the Cape River diggings are situated. He goes on to say :—

"The source of this branch of the Cape is from Mount Three Heads, so called from the fact that a tributary of Fletcher's Creek and Oxley Creek (a tributary of the Flinders) have their sources from the same hill. From Hann and Co.'s cattle-station on Fletcher's Creek, Mount Three Heads is distant 8 miles south, 38 west. Running down Oxley's Creek from its source to its junction with the Flinders, about 15 miles, gneiss, mica, and hornblende slate, with interstratified beds of quartzite, are found to occupy the whole distance.

"On the parallel and more northern tributary of the Flinders, called the

'Walker,' the gold-bearing metamorphic slates pass under the basaltic tablelands, and are hidden from sight. The lower 'Walker' may thus be assumed to be the north-western boundary of the Cape River series of auriferous rocks easily available to the miner.

"Looking from Mount Three Heads, towards the south-east, a broken country of hill and valley presents itself, a line of higher and more abrupt ridges marking the watershed. The creeks and gullies of this range, whether tributaries of the Cape, Flinders, or Betts's Mistake Creek, will, I believe, all be found to be auriferous, and many of them payable. The range itself follows nearly the strike of the metamorphic rocks of which it is composed, and especially at the south-eastern extremity. The dip is south-westerly. Between the upper Cape and Fletcher's Creek the ranges are of syenite. (I may mention here that this rock is a very good indication of gold. I have found it so in various parts of this colony, and in the part of Queensland under notice it is a prominent rock. Leichhardt noticed syenite at the head of the Lynd and on the Burdekin, in the hills below Mount M'Connell, which he thought was of domite, but Mr. Dalrymple has informed me it is granite. Mr. Gregory says that the summit of Mount M'Connell is marked by cliffs of porphyry, which also occurs on the right bank of the Suttor. These differences may be all reconciled, for syenite occasionally puts on a porphyritic appearance.)

"At the junction of Oxley Creek and the Flinders, on the east bank of the latter, cliffs of horizontal sandstone and conglomerate mark the boundary of what is called the 'desert country.' (Whether these rocks belong in part or at all to a carboniferous formation, Mr. Daintree does not state; but I have in my collections a coarse ferruginous quartz-grit from the table-land between the Cape and Flinders, and specimens of *coal* from the junction of Jardine's Creek, and fossilised wood from the delta of the Cloncurry and Flinders. These were brought to me by Mr. J. Atkinson. There is, therefore, a probability that coal-bearing beds do exist (a point on which Mr. Daintree expresses a doubt) below the fossiliferous secondary strata about O'Connell Creek, Walker's Creek, and Richmond Downs.)

"The cliffs above alluded to run parallel with the Cape range, and form the southern boundary of the auriferous belt under discussion.

"The area thus to be worked as 'Cape Diggings' will be 70 miles long by from 10 to 15 broad.

"It is bounded on the north-west by the lava of Walker's Plains; on the north by the syenite between Fletcher's Creek and the Cape; on the south by the sandstone and conglomerate of the desert. The south-eastern boundary is not yet determined: but it will be in that direction that deep leads will have to be looked for, the country being in that region flat as far as the junction with the Campaspe and the Cape, a distance of 50 or 60 miles.

"There were in the middle of July about 100 miners at work in two gullies called Specimen and Golden. The former of these rises in Mount Remarkable, an isolated hill at the south-eastern formation of the auriferous range which extends from Mount Three Heads."

Mr. Daintree, after confirming some other views of my own, gives a brief statement of the occurrence of Silurian rocks in Queensland. His opinion is that the Upper Silurian forms a belt from Brisbane to Broad Sound, extending to Maryborough and Rockhampton, the dip being at a high angle to north-east, and the strike parallel with the coast. Somewhat lower come in the Canoona and other gold-fields south-west of Maryborough, where the same Upper Silurian beds occur. On Perry's Range, Upper Burdekin, the dip is to south-west. These occur on the horizon of the Canoona field and represent the western side of an anticlinal, the summit of which has gone to form a portion of the enormous carboniferous formation, and as proved by the quartz in my fossiliferous Wollumbilla and Fitzroy Downs' auriferous calcareous rock, a portion of

the secondary formations that cover and conceal vast masses of the Lower Palæozoic or even older series of formations.

The only apparent difficulty in reconciling the age of the Silurian of the Broken River with that of the coast, is that the strike is there north to north-east, whilst to the south-eastward it is north-west. This difficulty may be overcome, if we regard the formation as mantling round a granitic axis. The slates of the Cape are represented as striking north-west, which ought to place them in the same category as the Silurian of the coast; the Broken River slates assume a more meridional direction.

I come now to a discovery by Mr. Daintree himself, in the extending of the northern gold-fields to the head of the Gilbert River. He says:—

“Although the area of the auriferous rocks is considerable both on the Cape and Clarke rivers, still it is small compared with the extent of the old metamorphic gold-bearing slates of the Upper Gilbert.

“The eastern tributaries of the Copperfield River, the western tributaries of M’Kinnon’s Lynd, the western and eastern tributaries of Jardine’s Einnasleigh River, all run through the mica-schists and other metamorphic formations.”

This is in close confirmation of the brief geological notices of Gregory and M’Kinlay.

The strike of the rocks in this region appear to have a trend to the eastward, according to the observations of Mr. Gregory; and this is confirmed by Mr. Daintree, who remarks as follows:—“The watershed between the Einnasleigh and the Burdekin, with several of the Upper Burdedin branch creeks, afford rock sections similar in every respect to the Cape diggings. As the main strike of the formation is north-easterly, and mica-schists are said to crop out on the coast at Endeavour River, and again on several parts of the Louisiade Archipelago, I think we may safely infer that auriferous tracts are continuous throughout, sometimes by large tracts of a horizontal sandstone series of unknown age, as on the upper portions of Leichhardt’s Lynd.”

Perhaps these inferences may be modified; but I have always expected another gold-field in the north, about the 144th meridian, on the heads of the Mitchell waters and the Kennedy River; nor is it unlikely that at the back of the east coast there are patches of auriferous country as far as 13° s.

The formations about Endeavour River are grey granite, schist, talc-slate, with quartz and flinty slate abutting on the granite; hornblendic granite occurring in the Turtle Islands, off the coast, and in Lizard Island, whilst to the north of Endeavour River, west of Cape Flattery, a table-land comes in, with a trend to s.w. by w., and from 500 to 600 feet high. The coast about Cape Grafton consists of grey granite and a tourmaline rock of granitic character. Northward, in Trinity Bay, contorted talc-schist, with quartz veins occurs, dipping 60° to s.w. This gives a strike about n.n.w. Mica-slate, contorted, occurs in the Barnard Islands to the south. Granite also occurs at Cape Melville and at Cape Direction, with flinty rock at Cape Sidmouth, and trap between it and the mouth of the Kennedy, both occurring with granite. Quartz also occurs abundantly in the neighbourhood of Cleveland Bay, at the back of which gold has been found. The general character of the coast of the York Peninsula to the 13th parallel is, therefore in agreement with the country six degrees more south and to the east of the Burdekin. I have not been able to have any of the rocks in the region just named subject to assay; but with respect to those of the Louisiade Archipelago, certain of them, especially the quartz, were assayed for me at the Mint some years ago, but without finding any gold in them. They consisted of slate, porphyry, &c.

Mr. Daintree goes on to say:—“I have not Leichhardt’s work to refer to as to the Geology of Kirchner’s Range, but since it lies in the strike of the Gilbert mica-schists, it is probably a schistose barrier.”

On making reference, I find Leichhardt does not distinctly state what is its formation; but he mentions talc-schist to the south-east of it, with syenite passing into hornblende rock and with scattered quartz crystals. To the north-westward, granite and pegmatite occurred. The trend of the ranges on the east bank of the river appears to be north-easterly and easterly.

I suspect that there are two divisions of the old palæozoic rocks in the region under review, and that some of the supposed "metamorphic" rocks are transmuted Lower Silurian, or perhaps Huronian. If so, gold will, probably, be hereafter found.

Supposing that the preceding observations have been founded on sufficient data, then, regarding the general trend of the *divisio aquarum* from the granitic Bellenden Kerr Hills above Rockingham Bay, south-westerly through the heads of the Lynd and Gilbert to the ranges of Burke and Wills at the head of the Cloncurry, where quartz reefs are known to exist, I would venture to anticipate, hereafter, a development of auriferous country also in the neighbourhood of M'Kinlay's Range, and to the westward, especially as Wills points out a quartz reef, and as on Landsborough's country along the Gregory and O'Shanassy rivers, which also head along the previously indicated water-parting, there is abundance of basalt, which not only occupies a similar prominent position at the head of the Lynd, but also occurs in the Bramston Range, on the Flinders, and near to the head of the Barkly River, in an extensive table-land.

Independently of the well-known Peak Down or Mount Drummond mines, copper occurs at the Dee Mountain and in various other localities. Mr. Daintree, however, has added a fresh locality on the Lynd River.

The discoveries of gold and copper and other metals are not merely valuable to individual explorers, but belong to all the colonies in general. Those who work them, and those who profit by them, are of no particular section of the community, nor of any given member of the Australian provinces.

Copper, I may say, is very extensively developed; and iron still more so. The latter metal is, we already know, extremely abundant in Queensland, and magnificent specimens of ore from the neighbourhood of Port Curtis were exhibited in Paris at the first French International Exhibition. There are also in New South Wales vast masses of iron of far more solid character than the Fitzroy ore; and such I found in the explorations I made through the colony fifteen or sixteen years ago.

Looking at the whole of the phenomena represented by the features of that region, it is certain that Nature has been there in a very active state producing such combinations of galvanic, magnetic, and chemical forces. The iron also forms solid hills and cliffs rising out of a desert to 50 and 60 feet in broad ridges, and appearing under most picturesque forms. Imagine an explorer passing a night in a cavern in the very heart of a cliff of iron! The copper before us seems very much akin to that which occurs on Lake Superior in North America. Its hade is to the west; that of Peak Downs is to the south, and that of Daintree's Lynd mine to E. 30° S. Inferences from what has been said in relation to the age of the formations in which these deposits occur may be drawn respecting the new finds.

The Lake Superior copper rocks are, however, Silurian. It is probable that the new copper mine in question may belong to a lower stage, perhaps as low as the Cambrian or (Huronian) itself. In each case eruptive rocks are present. Granite and mica-slate, with quartz veins holding micaceous iron and pyrites, are common rocks in the vicinity.

As showing how generally copper exists in the interior, we may notice that M'Kinlay mentions his having found copper during his journey through the wilderness.
